

NON-PUBLIC?: N

ACCESSION #: 8905150206

LICENSEE EVENT REPORT (LER)

FACILITY NAME: Quad Cities Unit Two PAGE: 1 OF 5

DOCKET NUMBER: 05000265

TITLE: Reactor Scram Due to Failure of Master Trip Solenoid Valve

EVENT DATE: 04/06/89 LER #: 89-001-00 REPORT DATE: 05/03/89

OPERATING MODE: 4 POWER LEVEL: 080

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10  
CFR SECTION  
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:

NAME: Bryan C. Hanson, Technical Staff Engineer, Ext. 2146

TELEPHONE: (309) 654-2241

COMPONENT FAILURE DESCRIPTION:

CAUSE: X SYSTEM: TG COMPONENT: SOL MANUFACTURER: V105

X TG ZI L206

REPORTABLE TO NPRDS: N

N

SUPPLEMENTAL REPORT EXPECTED: NO EXPECTED SUBMISSION DATE:

## ABSTRACT:

On April 6, 1989, Quad Cities Unit Two was in the RUN mode at 80 percent of rated core thermal power. At 0332 hours, a reactor scram occurred due to a Turbine Stop Valve Closure. This occurred while the Operating Department was performing weekly Turbine/Generator testing. NRC notification was completed at 0404 hours to comply with 10 CFR 50.72.

An investigation revealed that the cause for this event was component failure. The A pilot solenoid valve of the turbine master trip solenoid valve failed in the de-energized condition. Due to a stuck limit switch, the light indication continued to show the pilot solenoid valve energized. Thus, when the B master trip solenoid was tested, a turbine trip occurred. The failed solenoid was rebuilt and the coil and limit switch were replaced. The pilot solenoids are tested weekly. This report is provided to satisfy 10 CFR 50.73(a)(2)(iv).

1885H/0597Z

END OF ABSTRACT

TEXT PAGE 2 OF 5

## PLANT AND SYSTEM IDENTIFICATION:

General Electric - Boiling Water Reactor - 2511 MWt rated core thermal power.

EVENT IDENTIFICATION: Reactor Scram Due to Failure of Master Trip Solenoid Valve

#### A. CONDITIONS PRIOR TO EVENT:

Unit: Two Event Date: April 6, 1989 Event Time: 0332

Reactor Mode: 4 Mode Name: RUN Power Level: 80%

This report was initiated by Deviation Report D-4-02-89-019.

RUN Mode (4) - In this position the reactor system pressure is at or above 825 psig, and the reactor protection system is energized, with APRM protection and RBM interlocks in service (excluding the 15% high flux scram).

#### B. DESCRIPTION OF EVENT:

At 0320 hours on April 6, 1989, Quad Cities Unit Two was in the RUN mode at approximately 80 percent of rated core thermal power. The Operating Department was in the process of performing QOS 5600-4, Weekly Turbine TA! Generator TB! Test. As part of this surveillance, the two pilot solenoid SOL! valves (PSV) PSV! of the Main Turbine's Master Trip Solenoid Valve (MTSV) are individually tripped and reset to verify operability. At 0320 hours, the Nuclear Station Operator (NSO) on Unit Two had turned the master trip solenoid test switch HS! at control panel 902-7 PL! to the "TRIP A" position. However, the light indication IL! for the A PSV did not extinguish as expected. Two additional attempts were made to trip the A PSV. Since the A PSV light was still illuminated, it was believed that the A PSV was energized. Therefore, at 0332 hours, the NSO, as instructed by the Shift Engineer (SE), moved the test switch to the "TRIP B" position. When the B PSV light extinguished, the MTSV was tripped and a turbine trip occurred due to loss of fluid

pressure in the turbine hydraulic trip system TG!. This caused a reactor RCT! scram JC! due to Turbine Stop Valve Closure. The expected reactor water level transient due to the collapse of voids following the scram caused reactor vessel level to drop below inches which caused Group II and III primary containment isolations (PCI) JC!, Reactor Building Ventilation VA! and Control Room Ventilation VI! isolations, and Standby Gas Treatment BH! initiation. Additionally, a Group I PCI, Main Steam Isolation Valve closure (MSIV), was received. Reactor water level was restored automatically by the Feedwater System JB! and a normal scram recovery proceeded. The Group I, II, and III isolations were promptly reset. NRC notification using the Emergency Notification System (ENS) was completed at 0404 hours to comply with the requirements of 10 CFR 50.72(b)(2)(ii).

Electrical Maintenance (EM) personnel found the relay coil of the A solenoid valve to be burnt and the contacts of the limit switch for the solenoid valve to be sticking together. The failed solenoid valve was rebuilt, a new coil was installed, and the limit switch was replaced under Work Request Q74907.

1885H/0597Z

TEXT PAGE 3 OF 5

The Group I isolation signal, which was unexpected for this transient, is hypothesized to be from the PCI reactor low pressure setpoint. When the turbine tripped, all nine bypass valves opened as designed. It is believed that the main steam line pressure spiked low within the range of the setpoint (850 psig, 0 psig) within two seconds of the turbine trip. The NSO placed the mode switch to SHUTDOWN bypassing the Group I

low pressure isolation signal five seconds after the turbine trip. The reactor pressure recorder showed that reactor pressure did drop to approximately 855 psig.

At 1000 hours on April 6, 1989, the Unit Two NSO commenced startup while repairs were being made to the turbine MTSV. At 2010 hours on April 6, 1989, with Unit Two in the STARTUP mode, EM personnel completed replacement of the faulty pilot solenoid and limit switch. The new solenoid was tested several times and verified operable. At 0121 hours on April 7, 1989, the main generator TB1 was synchronized to the grid FK1.

#### C. APPARENT CAUSE OF EVENT:

This event is being reported according to 10 CFR 50.73(a)(2)(iv), which requires the reporting of any event or condition that results in manual or automatic actuation of any Engineered Safety Feature (ESF), including the Reactor Protection System (RPS).

The cause of this event was component failure apparently due to aging and cyclic fatigue. The primary failure was the failure of the A pilot solenoid valve in the de-energized state. This happened when the A pilot solenoid overheated and shorted. This occurred during one of the attempts to test this solenoid during this surveillance and was most likely due to aging and cyclic fatigue.

The failed limit switch contributed to this event by indicating in the Control Room that the solenoid was in the energized position, allowing testing of the B solenoid. The limit switch contacts stuck together. This was also most likely due to aging and cyclic fatigue.

With the A PSV failed in the de-energized state and the limit switch stuck, when the NSO moved the test switch to the "TEST B" position, the B PSV de-energized. This resulted in the trip of the MTSV, allowing the Emergency Trip Supply (ETS) hydraulic oil to drain directly into the drain header, resulting in the loss of ETS pressure. The loss of ETS pressure caused a turbine trip, resulting in closure of the stop valves.

#### D. SAFETY ANALYSIS OF EVENT:

The safety significance of this event is minimal. All expected ESF actuations occurred to bring the reactor to a safe shutdown condition. The Turbine Stop Valve Scram occurs when the stop valves are less than 90% full open. This scram is intended to prevent exceeding the minimum critical power ratio (MCPR) safety limit by anticipating the rapid increase in pressure, neutron flux, and heat flux which results from a fast closure of the turbine stop valves. If the Turbine Stop Valve Scram had failed, the reactor scram would still have occurred from an APRM high neutron flux.

1885H/0597Z

TEXT PAGE 4 OF 5

The main turbine master trip solenoid valve is part of the turbine emergency trip solenoid valve assembly. The MTSV is controlled by two DC solenoid valves attached to the manifold of the main valve. The two solenoid valves are connected in parallel with the pilot side of the main valve. When the two solenoid valves are de-energized, they allow hydraulic oil to drain from the pilot side of the main valve causing the

main valve to shift. The main valve is then positioned to allow hydraulic fluid to drain from the turbine trip system resulting in a turbine trip. When at least one of the solenoid valves is energized, the pressure on the pilot side of the valve is maintained and pressure in the ETS is maintained. Therefore, when the A pilot solenoid failed in the de-energized position without proper light indication and the B pilot solenoid was de-energized as part of the test, both pilot solenoids were open and a loss of ETS pressure occurred as designed.

Also, since this is a weekly surveillance and was performed successfully the previous week, these failures must have occurred within the week previous to this event and probably occurred during the performance of this surveillance just prior to the turbine trip.

#### E. CORRECTIVE ACTIONS:

The immediate corrective action was to replace the failed solenoid and limit switch.

Subsequent corrective actions will include a procedure revision to enhance QOS 5600-4, replacement of the A and B pilot solenoids on Unit One during the next refuel outage, development of a preventive maintenance program for the EHC system, revision of the procedure writers' guide, and an investigation into the Group I isolation.

The surveillance procedure, QOS 5600-4, will be revised to include appropriate cautions if portions of the test do not work properly (NTS 2652008901901).

As a preventive maintenance action, the A and B pilot solenoids on Unit

One will be replaced to preclude any possible aging failures (NTS 2652008901902).

A preventive maintenance program for the entire EHC system will also be developed by the system engineer (NTS 2652008901903).

The new procedure writers' guide will contain instructions on when cautions should be incorporated into procedures to explain what to do if a portion of the surveillance fails or cannot be performed (NTS 2652008901904).

An investigation will be conducted into the Group I isolation (NTS 2652008901905).

#### F. PREVIOUS EVENTS:

There has been one previous occurrence of a turbine trip being caused by a failure of a MTSV pilot solenoid valve. On December 10, 1987, the Quad Cities Unit Two turbine tripped as a result of a failed pilot solenoid valve as documented in LER 265/87-020, Unit Two Scram Due to Failure of Turbine Master Trip Solenoid Valve. The B pilot solenoid failed in the de-energized position as shown by light indication. Surveillance testing was stopped. Approximately an hour later, the A pilot solenoid valve de-energized due to insufficient current. The short across the B pilot solenoid was pulling the voltage down for the A pilot solenoid and therefore allowed the A solenoid to de-energize.

1885H/0597Z

G. COMPONENT FAILURE DATA:

The pilot solenoid which failed was manufactured by Sperry Vickers Division, Inc., Model No. F3-SDG-454-012A. The Electro Hydraulic Control (EHC) system is not reportable in the Nuclear Plant Reliability Data System (NPRDS); therefore, the MTSV is not reportable. The limit switch that failed is manufactured by Licon, Model No. 14-324, and there were no other failures of Licon limit switches in NPRDS.

1885H/0597Z

ATTACHMENT 1 TO 8905150206 PAGE 1 OF 1

CE Commonwealth Edison  
Quad Cities Nuclear Power Station  
22710 206 Avenue North  
Cordova, Illinois 61242-9740  
Telephone 309/654-2241

RLB-89-092

May 4, 1989

U. S. Nuclear Regulatory Commission  
Document Control Desk  
Washington, DC 20555

Reference: Quad Cities Nuclear Power Station  
Docket Number 50-265, DPR-30, Unit Two

Enclosed is Licensee Event Report (LER) 89-001, Revision 00, for Quad Cities Nuclear Power Station.

This report is submitted in accordance with the requirements of the Code of Federal Regulations, Title 10, Part 50.73(a)(2)(iv): the licensee shall report any event or condition that resulted in manual or automatic actuation of any Engineered Safety Feature (ESF), including the Reactor Protection System (RPS).

Respectfully,

COMMONWEALTH EDISON COMPANY  
QUAD CITIES NUCLEAR POWER STATION

R. L. Bax  
Station Manager

RLB/AAF/ad

Enclosure

cc: R. Stols  
R. Higgins  
INPO Records Center  
NRC Region III

1935H

\*\*\* END OF DOCUMENT \*\*\*

---